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R. C. BAKER ET AL
 DRILL PIPE FLOAT VALVE
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Fig. 1.

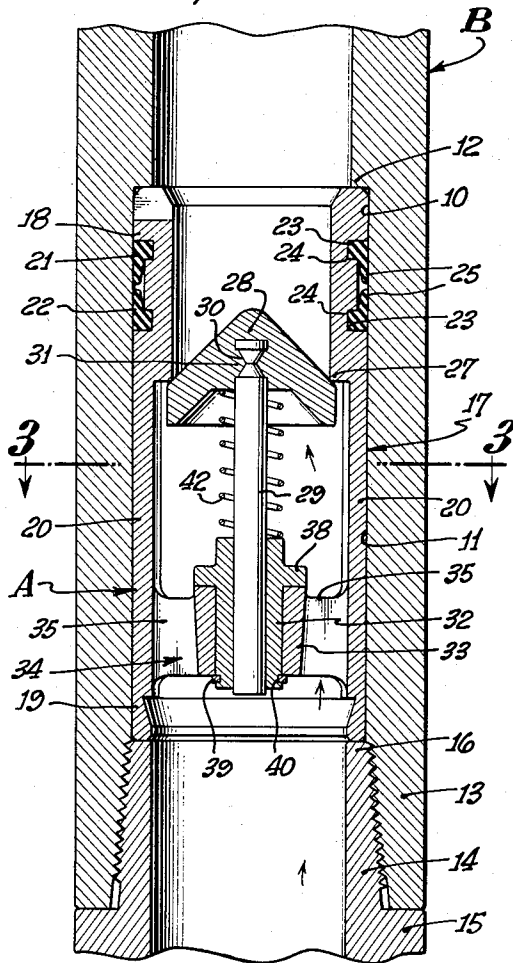


Fig. 2.

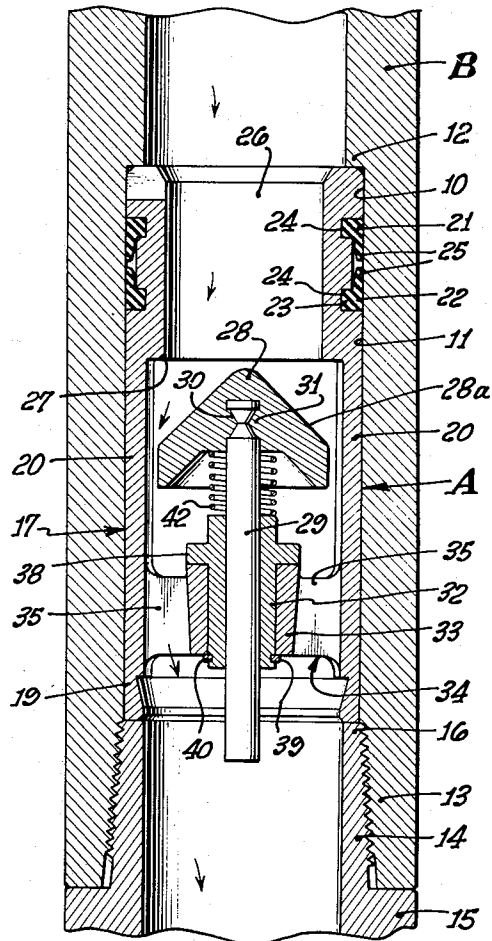
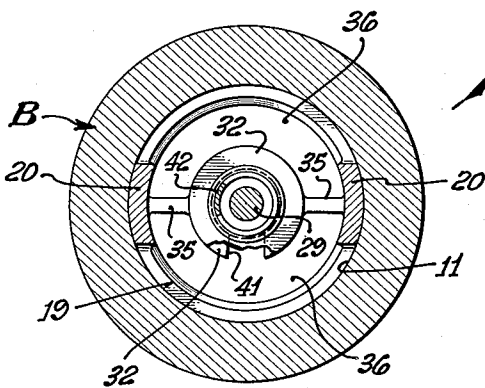


Fig. 3.



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DRILL PIPE FLOAT VALVE

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3 Claims. (Cl. 137—515.7)

The present invention relates to subsurface well apparatus, and more particularly to valves to be incorporated in drill pipe for the purpose of preventing upward flow of fluids therethrough.

Drill pipe float valves are incorporated in strings of drill pipe disposed in well bores to accomplish several desirable purposes. Since a valve of the type indicated closes in an upward direction and opens in a downward direction, it is instrumental in floating a string of drill pipe in the hole as the drill pipe is being lowered therein. Accordingly, it relieves the derrick and rig equipment of a substantial portion of the weight of the string of drill pipe. Moreover, it reduces the danger of the bit on the lower end of the drill pipe string from plugging, as well as eliminating the annoyance of fluid filling the drill pipe and overflowing at the top of the hole, which will effect wetting of the surface equipment, the working area, and the working personnel. By preventing upward flow of fluid through the drill pipe, it minimizes and oftentimes entirely prevents blowouts or other damage in the event the drilling string should part.

Since the valve opens in a downward direction, it allows full and unimpeded pumping of drilling muds, and like fluids, down through the drill pipe and out of the bit, to carry the cuttings upwardly around the drill pipe to the top of the hole. Such downward pumping of fluid through the drill pipe float valve is attended with erosive wear on the parts, which reduces the effective and efficient life of the valve.

An object of the present invention is to provide a drill pipe float valve in which erosion of its parts by the drilling fluid is reduced greatly, thereby considerably increasing the life of the parts and the efficiency of the valve.

Another object of the invention is to provide a drill pipe float valve embodying a lesser number of non-metallic seal elements, the parts still being maintained in fluid tight relation when the valve is closed.

A further object of the invention is to provide a drill pipe float valve in which the valve opens fully when fluid is pumped down the drill pipe, regardless of a comparatively low or high rate of fluid flow, and in which the valve shifts quickly to a fully closed position in the event upward flow of fluid in the drill pipe tends to occur.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section through a string of drill pipe, with a drill pipe float valve embodied therein, the valve being disclosed in closed position;

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Fig. 2 is a view similar to Fig. 1, with the valve in fully open position;

Fig. 3 is a cross-section taken along the line 3—3 on Fig. 1.

The valve mechanism A is disclosed in the drawings as incorporated within a string of drill pipe B, which extends to the top of the hole, and through which the drilling fluid is pumped in a downward direction as the drill pipe is rotated, to rotate the bit (not shown) on its lower end. The valve device can be incorporated at any convenient point along the length of the drill pipe. As shown, it is mounted within a drill collar B, which is ordinarily placed at the lower end of the drill pipe string, and immediately above the drilling bit. The drill collar or drill pipe section may have an enlarged bore 10, providing a cylindrical wall 11 and an upper transverse shoulder 12. This drill collar or drill pipe section has its lower threaded box 13 threaded upon the upper pin end 14 of an adjacent drill pipe section 15. As a matter of fact, the box may be threaded onto the upper pin end of the main body of a drill bit 15.

The upper transverse shoulder 12 and the upper pin end 16 of the bit 15, or lower drill pipe section 15, form a pair of opposed longitudinally spaced stops for confining the valve body or cage 17 of the valve mechanism. This valve body or cage has an outside diameter just slightly less than the diameter of the cylindrical wall 11 of the enlarged drill pipe bore 10, and the length of the valve body may be slightly less than the longitudinal distance between the upper transverse shoulder 12 and the upper pin end 16 of the lower drill pipe section 15.

The valve body or cage 17 may consist of an upper cylindrical portion 18 and a lower cylindrical portion 19 interconnected by a plurality, such as a pair, of longitudinally spaced bars or ribs 20. The upper cage portion 18 is provided with a pair of opposed side seals 21, 22, which may be in the form of cup-shaped packings whose base portions 23 are received within circumferential grooves 24 in the valve body, the lip portions 25 of the packing or sealing members being engageable with the cylindrical wall 11 of the enlarged bore portion 10 of the drill pipe B, and facing toward each other. It is quite evident that the lower seal ring member 22 precludes downward flow of fluid between the valve body 17 and the drill pipe or drill collar section B; whereas the upper packing member 21 precludes upward flow of fluid between the valve body 17 and the drill collar or drill pipe section B.

The valve cage or body 17 has a comparatively large bore or passage 26 therethrough for the flow of fluid. The upper portion of this passage is cylindrical and terminates in a lower valve seat 27 which is engageable by a longitudinally movable valve member or head 28. This head is suitably secured to a valve stem 29 depending therefrom, as by casting the head 28 on the upper end of the valve stem, the stem being provided with a peripheral groove 30 into which the cast metal can flow, providing a circumferential flange or rib 31 within the stem groove 30. The stem 29 extends downwardly from the head 28, being freely slidable through an elongate valve guide 32, which extends through the hub portion 33 of a spider 34, the latter being secured to the lower cylindrical portion 19 of the valve cage or body by a plurality, such as a pair, of diametrically opposed ribs 35. The arcuate spaces 36 between the ribs 35 and the lower cylindrical portion 19 of the valve body 17 provide passages through which the fluid moving down through the string of drill pipe can flow, when the valve head 28 is removed in a downward direction from engagement with its companion seat 27.

It is to be noted that the upper and lower cylindrical portions 18, 19 of the body 17, the longitudinal ribs or

bars 20, the radial ribs 35 and the hub 33 are all integral with one another. The valve guide 32 is a separate member, but is, nevertheless, firmly secured to the valve body. As disclosed, the guide 32 has an upper flange 38 resting upon the upper portion of the hub 33, this flange being held firmly against the upper end of the hub by a split, snap retaining ring 39 fitting within a lower peripheral groove 40 in the guide 32 and snugly engaging the lower end of the hub 33. It is apparent that the upper guide flange 38 prevents downward movement of the guide 32 with respect to the valve cage 17, whereas the retaining ring 39 prevents upward movement of the guide 32 with respect to the hub 33 and valve cage 17.

To facilitate assembly of the valve, the hub 33 has a longitudinal slot 41 therethrough slightly wider than the diameter of the stem 29. In assembling the parts in the cage 17, the guide 32 is placed on the stem 29 and against the head 28, these parts then being inserted laterally into the cage 17, with the lower part of the stem passing through the hub slot 41. The guide 32 is then shifted down into the hub 33 and the split retainer ring 39 mounted in place.

The valve stem 29 is freely slidable through the guide 32, being capable of moving in downward and upward directions, as the valve head 28 moves out of and into engagement with its companion valve seat 27. It is desired that the valve head 28 move downwardly to its fully open position, even when a comparatively low volumetric rate of fluid is being pumped down through the drill pipe B. However, the valve 28 should move upwardly into engagement with its seat 27 from a fully open position in a rapid manner, to preclude upward flow of fluid in the drill pipe. To accomplish these objectives, the valve head 28 is urged upwardly toward engagement with its companion seat 27 by a comparatively light helical spring 42 which surrounds the valve stem 29, the lower end of the spring engaging the upper end of the guide 32, which forms a seat for the spring, the upper end of the spring engaging the valve head 28 itself. This spring exerts only a comparatively small force, the force being only slightly greater than the weight of the valve head 28 and valve stem 29 itself. In addition, the spring should also exert enough force to overcome any friction that might exist between the valve stem 28 and the valve guide 32, which is normally comparatively small.

It will be apparent that with the provision of the light spring 42 only a small fluid pressure in the drill pipe above the valve is sufficient to shift the valve 28 downwardly to its full extent against the force of the spring, to the fully open position illustrated in Fig. 2. When in this position, the fluid in the drill pipe can pass in a relatively unimpeded manner down through the upper portion 18 of the valve body 17, around the valve head 28 and down through the arcuate passages 36 between the ribs 35 for continued downward flow through the drill bit 15 or drill pipe section or sections therebelow. In the event any tendency for reverse flow of fluid in the upward direction tends to occur, then the spring 42 is immediately available to exert a force moving the head 28 rapidly into engagement with its companion seat 27.

Accordingly, the valve member 28 will occupy a fully open position, regardless of a low rate of fluid being pumped down through the drill pipe B, or a high rate of fluid. Since the valve 28 is always at its fully open position when downward pumping of fluid through the drill pipe occurs, there is no throttling action on the fluid as it moves between the valve seat 27 and the valve head 28, and, in view of the lack of such throttling action, there is no acceleration of the fluid between the head and the seat, which is ordinarily associated with erosive wear on the parts.

Heretofore, it has been the practice to include a seal ring between the valve head 28 and the valve seat 27, and to cause the head 28 and seat 27 to engage one another over a substantial surface of contact. With such arrange-

ment of parts, erosive wear sometimes occurred on the parts in comparatively short order, which shortened the life of the valve device considerably. Such erosive wear is eliminated, as well as the rubber or other non-metallic seal ring between the valve head and valve seat in the present instance, by causing the valve head 28 to engage a seat 27 only along a narrow or circumferential line of contact rather than over a surface contact. This line of contact enables a metal-to-metal seal to be provided between the valve head 28 and the valve seat 27, which metallic seal does not leak, in the event upward flow of fluid through the valve device tends to occur. It has also been found that the provision of the relatively circumferential line seat 27, rather than an extended seating surface, as was employed heretofore, has also increased the lift of the parts to a considerable extent, since substantially no erosive wear occurs on the seat. This was not the case when a surface contact was provided.

To insure the proper centering of the valve head 28 with respect to the seat 27, it is preferred to make the upper end 28a of the valve head tapered or conical in shape, the tapered surface converging in an upward direction. It is quite evident that this type of valve head 28 becomes self-centering with respect to the seat 27, and insures a complete circumferential seal against its companion seat.

Thus, erosive wear is greatly minimized with the present valve construction because of two factors. The first factor involves the circumferential narrow or line of contact between the seat 27 and the valve head 28; and the second factor involves the use of the light spring 42 urging the valve head upwardly into engagement with its seat. The spring, as stated above, exerts a force that is only slightly greater than the weight of the valve head 28 and valve stem 29, so that fluid being pumped down the drill pipe at a low rate insures the full opening of the valve head away from its seat, such full opening being maintained, regardless of the rate of flow. The erosive wear on the parts is minimized considerably by the above construction, which also effects economy in production of the valve assembly, inasmuch as a non-metallic seal between the valve head and the seat need no longer be used, as in prior devices.

The inventors claim:

1. In a drill pipe float valve: a valve body having a metallic valve seat; a metallic valve head movable upwardly into engagement with said seat, said valve head engaging said seat only along substantially a circumferential line of contact; said body having a central hub portion below said head; a separate valve guide removably mounted in said hub portion and having a flange engaging one end of said hub portion to prevent longitudinal movement of said guide in one direction; retaining means on said guide engaging the other end of said hub portion to prevent longitudinal movement of said guide in the opposite direction; a valve stem secured to and depending from said head and slidable in said guide; and spring means surrounding said stem and engaging said head and guide to urge said head toward engagement with said stem, the force exerted by said spring means upon said valve head when it engages said seat being only slightly greater than the combined weights of said valve head and stem, whereby said valve head moves downwardly to a fully open position when a very low fluid pressure is imposed thereon.

2. In a drill pipe float valve: a valve body having a metallic valve seat extending circumferentially around the body and being exceedingly narrow in width to provide a circumferential line of contact with a metallic valve head; said metallic valve head having an upwardly converging external conical surface movable upwardly with said valve head into engagement with said seat and extending upwardly beyond said seat when engaged therewith; said body having a central hub portion below said head; a separate valve guide removably mounted in said

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hub portion and having a flange engaging one end of said hub portion to prevent longitudinal movement of said guide in one direction; retaining means on said guide engaging the other end of said hub portion to prevent longitudinal movement of said guide in the opposite direction; a valve stem secured to and depending from said head and slidable in said guide; and spring means surrounding said stem and engaging said head and guide to urge said head toward engagement with said seat, the force exerted by said spring means upon said valve head when it engages said seat being only slightly greater than the combined weights of said valve head and stem, whereby said valve head moves downwardly to a fully open position when a very low fluid pressure is imposed thereon.

3. In a drill pipe float valve: a valve body having a metallic valve seat extending circumferentially around the body and being exceedingly narrow in width to provide a circumferential line of contact with a metallic valve head; said metallic valve head having an upwardly converging external conical surface movable upwardly with said valve head into engagement with said seat and extending upwardly beyond said seat when engaged therewith; said body having a spider portion below said head through which fluid can flow, said spider portion including a central hub; a separate valve guide removably mounted in said hub and having a flange engaging the upper end of said hub to prevent downward movement

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of said guide in said hub; a retainer on said guide engaging the lower end of the hub to prevent upward movement of said guide in said hub; a valve stem secured to and depending from said head and slidable in said guide; and a helical spring surrounding said stem and engaging said head and guide to urge said head upwardly toward engagement with said seat and said guide downwardly to hold said flange engaged with the upper end of said hub, the force exerted by said spring upon said valve head when it engages said seat being only slightly greater than the combined weights of said valve head and stem, whereby said valve head moves downwardly to a fully open position when a very low fluid pressure is imposed thereon.

References Cited in the file of this patent

UNITED STATES PATENTS

1,162,416	Teter	Nov. 30, 1915
1,660,634	Thomas	Feb. 28, 1928
1,767,538	Mahan	June 24, 1930
1,846,446	Maynard	Feb. 23, 1932
1,984,107	Baker	Dec. 11, 1934
2,117,533	Baker	May 17, 1938
2,182,278	Brauer	Dec. 5, 1939
2,192,670	Adkins	Mar. 5, 1940
2,314,059	Steiner	Mar. 16, 1943